NEW YORK STATE DEPARTMENT OF TRANSPORTATION

Span Wire Analysis Program

July, 2013

User's Manual

Version 2.0.0

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New York State Department of Transportation
Office of Design
Albany, NY

DISCLAIMER

No Warranty is expressed or implied by the Office of Design of the New York State Department of Transportation as to the accuracy and functioning of this program nor shall the fact of distribution of this program constitute any such warranty; and no responsibility is assumed by the Office of Design of the New York State Department of Transportation in any connection therewith.

Table of Contents

Introduction

This Program shall be used to determine the pole load on Tethered and Non-Tethered Span Wire Traffic Signal Poles. It utilizes the same methods found in Engineering Instructions EI 83-38 (Method for calculating the loads applied to span wire traffic signal poles) and EI 89-003 (Method for calculating the loads applied to span wire traffic signal poles: Non-Tethered). These two methods shall apply to traffic signals and/or signs suspended on a cable between poles with the ends of the cable attached to the poles at the same elevation. The length of the poles need not be equal. However, in such cases, the stiffness of the stiffer pole shall be used.

The 2003 Version 1.0.1 of this program was designed to replace the outdated "Traffic Signal Pole Design Program (Version 1.5)", which had been in use by NYSDOT since 1987.

The 2003 improved Span Wire Analysis Program was prepared as a cooperative effort by the Office of Design and the former Information Services Bureau (ISB). It was developed using Visual Basic. Many new features and capabilities were added and/or improved since the previous DOS-based version. Although the Engineering Instructions were in US Customary units, the Span Wire Analysis Program allows the user to run the analysis in either US Customary or Metric Units. Files can now be saved and retrieved at any time.

The 2013 Version 2.0.0 is a modification of the 2003 Visual Basic version. Key changes are the ability to include either 5 inch or 8 inch back plate widths, modeling of the 5-lens "doghouse" configuration, allowance for LED signs (as a heavier sign type), permitting back plates on aluminum heads, and permitting back plates on more than two- and three-lens heads.

As always, user comments and suggestions are appreciated. Many thanks to those of you who have helped develop this 2.0.0 version. Please send comments or suggestions to:

NYS DOT – Office of Design
Design Quality Assurance Bureau
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Getting Started

Before you start the program it is strongly recommended that a diagram of the proposed signal installation be developed and labeled. A sample diagram has been included in Appendix C. Remember that pole height and location depends on many factors. Analysis of a Span Wire Traffic Signal should be an interactive process. Placement of poles depends on Right Of Way (ROW), buried utilities, and Vertical Clearance. As a good design engineer, you should always consider constructability. It is good practice to gather all necessary information before getting started using the program. It will make your life a lot easier!

Another diagram (worksheet) has been included in Appendix B to help you determine the span wire mounting height based on vertical clearance. It is strongly recommended that you print this page to help you determine the height of the poles.

Besides gathering information on the physical layout of the span wire signal, the user must identify the types of materials that will be used (Aluminum, Polycarbonate, Glass, LED, etc).

The methodology used in this program is based on the methods found on EI 83-38 and EI 89-003. We have tried to make the program as flexible as possible. Sign and signal specifications can be found in Appendix A (page 13). Specifications have been revised to reflect both old and new materials used in span wire signal assemblies. Please make sure you take a look at the spec table before you run the program.

NOTE: The non-tethered analyses are based on data obtained from a limited number of wind tunnel tests which the researchers extrapolated to a slightly wider range of similar configurations. The team responsible for developing this version of SpanWire deemed it inappropriate to extrapolate those results still farther to cover head configuration that have come into more common use, such as the doghouse (1section over 2 over 2) configuration. This decision is partially justified by a solid trend to discontinue installation of untethered span wire systems.

A brief Tour of the Span Wire Analysis Program

The first input screen is shown in Figure 1. This is the screen you will see every time you run the Span Wire Analysis Program. Most entries will be blank with the exception of a few defaults.

Figure 1

NOTE: *SpanWire can not handle a head where the number of sections differs from one way to another. If a single head has three sections pointing in one direction and a doghouse 5 pointing in the other, it should be modeled as two separate heads with a distance between the point loads of 0.1 feet or 0.1 meters.*

In Figure 2, all entries have been filled and we are ready to continue with the analysis. Figure 3 shows the next input screen. Information about each point load is entered there.

Figure 2

Figure 3

NOTE: Make sure that the number of sections entered for a head is the sum for all directions. (A 2-way head with 3 sections per way should be entered as 6 sections.)
The output screen is shown in the figure below (Figure 4). The user has the option to either preview what the output would look like as a printed report or to return to the project data entry page.

Figure 4

Definitions

INPUT:

1. **Point Load:** Any object whose load (weight) is concentrated at a single point (i.e. signal heads, signs, etc).

2. **Span Length**: The distance between the signal poles in feet or meters.

3. **Type of Load:** Either a signal head assembly or sign assembly.

4. **Signal Material Type:** Either aluminum or polycarbonate.

5. **Signal Lens Material:** Either glass or LED.

6. **Number of Directions (Ways):** The number of directions a point load faces.

7. **Number of 8" Sections:** Total number of 8" sections per signal head assembly.

8. **Number of 12" Sections:** Total number of 12" sections per signal head assembly.

9. **Backplate:** User must indicate back plate selection for a signal head assembly (None, 5-in, or 8-in).

10. **Backplate Material:** Either Aluminum or plastic.

11. **Disconnect Hanger:** User must indicate if a signal head assembly uses a disconnect hanger.

12. **Sign Hanger:** User must indicate if a sign is to be mounted as a single panel, perpendicular, back to back, or box kite assembly.

13. **Area of Sign:** Any value in square feet (sf) or square meters (sm). Sign dimensions can be found in the Manual on Uniform Traffic Control Devices (MUTCD). If more than one panel is used, the average panel area should be entered.

14. **Distance between Point Loads:** The distance measured from one point load to the next. These distances are measured from the left pole to the first point load and continue from point load to point load until the last point load is reached. The program calculates the remaining distance between the last point load and the right pole.

OUTPUT:

1. **Dead Load:** The load due to the weight of the point loads.

2. **Ice Dead Load:** The load due to the weight of the ice acting on the point loads.

3. **Left Reaction:** The portion of the dead load transmitted to the left support.

4. **Right Reaction:** The portion of the dead load transmitted to the right support.

5. **Sag:** The vertical difference in feet or meters between the low point and the mounting height of the span wire (usually 5% of the span length).

6. **Zero Shear:** The distance from the left support to the point of zero shear due to the dead load.

7. **Resultant HD:** Horizontal force resulting from the **dead** load at the attachment point on the pole. This reaction is obtained by resolving the moments of the dead loads about the point of zero shear.

8. **Left Reaction Ice:** The portion of the ice load transmitted to the left support.

9. **Right Reaction Ice:** The portion of the ice load transmitted to the right support.

10. **Zero Ice Shear:** The distance from the left support to the point of zero shear due to the ice load.

11. **Resultant Hi:** Horizontal force resulting from the **ice** load at the attachment point on the pole. This reaction is obtained by resolving the moments of the ice loads about the point of zero ice shear.

12. **Pole Height No. 1:** The height of the left pole in feet or meters.

13. **Pole Height No. 2:** The height of the right pole in feet or meters.

14. **Group Loading 1 (tethered):** The loading due to the dead load acting on the support (DL).

15. **Group Loading 2 (tethered):** The loading due to the sum of the dead load and wind load acting on the support (DL + WIND).

16. **Group Loading 3 (tethered):** The loading due to the sum of the dead load, ice load and one half of the wind load acting on the support (DL + ICE + ½ WIND).

17. **Design Loading (tethered):** The load that the signal poles must support. This value is the greater of either the Group Loading 2 or Group Loading 3 rounded up to the next higher thousand pound increment. Since the design load maybe different for each signal pole, the value is listed for both poles.

18. **Wind Load:** The loading created by the wind (see standard spec 724-03 for wind speeds in different Counties).

19. **Ftg. Moment:** The moment at the base of the support. This value is listed for each pole in ft-kip or N-m.

20. **Group Loading 1 (Non-tethered):** The loading due to the dead load acting on the support (DL).

21. **Group Loading 2 (Non-tethered):** The loading due to the dead load plus the wind load acting on the support: $(DL^2 + WIND^2)^{1/2}$.

22. **Group Loading 3 (Non-tethered):** The loading due to the dead load, ice load and one half of the wind load acting on the support: $[(DL + ICE)^2 + (½ WIND)^2]^{1/2}$.

23. **Pole Deflection Rate:** Deflection rate due to the Horizontal Force in in/100 lb or mm/500N.

Using the Program

If you are running the program for the first time, click on the short cut for the Span Wire Analysis Program. The shortcut can be found under:

Start → Programs → Span Wire Analysis Program ▶ → Span Wire Analysis Program
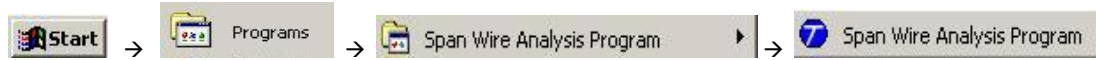
The project input screen will open (Figure 1, page 4). At this point you are ready to enter the project information:

1.   Type the Project name, Designer Name, Intersection Name, PIN and Signal Number
2.   Select the respective County from the drop down menu
3.   Select Working Units (English or Metric)
4.   Select Cable Type (tethered or non-tethered)
5.   Enter the span length (**3 decimals for Metric**)
6.   Enter the sag percentage. The default value has been set to 5%
7.   Enter the height of poles (**3 decimals for Metric**)
8.   Enter the number of point loads (signals and signs)
9.   Press the OK button

NOTE: If you leave any field entry blank, the program will give you a warning message. Make sure that all fields are completed.

NOTE: At this point, you can choose to exit the program. If you press the exit button, you'll be prompted to save your file (Figure 5). If you press "**Yes**", the Save dialog box will be opened (Figure 11, page 12). If you press "**No",** a final warning message will be displayed (Figure 6). This is your last chance to save your file. If you press **cancel**, you will be directed back to the first input screen (Figure 1, page 4).
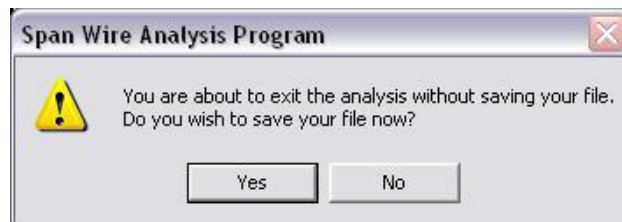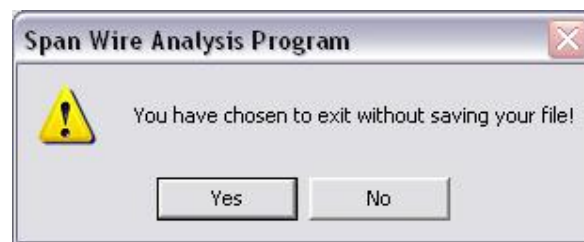

Figure 5

Figure 6

Any project information entered here can be changed and edited later on. More on editing saved files will be covered later in this section.

After you have entered all necessary information and press **OK**, the next input screen will be displayed (figure 3, page 5). Point load numbers will automatically appear in this window. Remember that point loads are **numbered in ascending order from left to right pole**. For each load number:

1.   Select type of load (Signal, Sign, or LED Sign).
2.   If type of load = Signal, select the material type (Aluminum or polycarbonate)
3.   If type of load = Signal, select the lens material (Glass or LED)
4.   If type of load = Signal, select the number of directions or ways that the signal faces
5.   If type of load = Signal, enter the total number of 8" sections (enter "0" if none)
6.   If type of load = Signal, enter the total number of 12" sections (enter "0" if none)
7.   If type of load = Signal, determine if disconnect hanger is used
8.   If type of load = Signal, determine back plate selection (None, 5-in, 8-in)
9.   If type of load = Sign or LED Sign, select Sign Hanger (single panel, perpendicular, back to back or box kite)
10.   If type of load = Sign or LED Sign, enter the area of sign
11.   Enter the distance between point loads
12.   Press "Update Analysis"

After pressing "**Update Analysis**", the following message will be displayed (Figure 7):
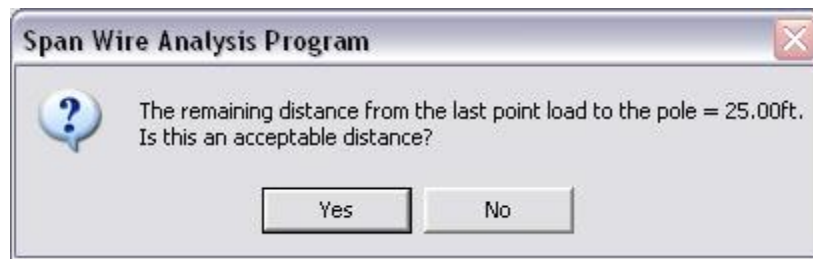
Figure 7

If the distance from the last point load to the right pole is NOT correct, press "**No**" and revise your data. If the remaining distance is correct, then press "**Yes**". The output screen will be displayed (Figure 4, page 5). If you wish to print the analysis report, press "**PREVIEW**" and then press "**PRINT**".   When finished printing, close the window and close the output screen by pressing the "**CLOSE**" button. A dialog box (Figure 8) will appear asking if you want to run additional analyses. Whether you want to change the current data or not, a subsequent window will give you the opportunity to save your current data.

Figure 8

If you select "Yes" when asked if you want to make changes (Figure 8), you will be returned to the Main screen, where you can select File >> Save to save your current data before proceeding to change it or run another analysis.

Figure 9

If, instead, you select "No", the following dialog box will appear.
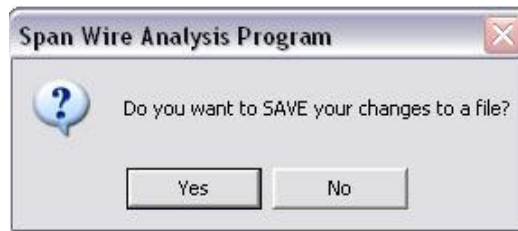
Figure 10

If you again select "No", the program will close. If you select "Yes", the Save dialog box will open, allowing you to navigate to the folder you wish to store the data in. Once you store it and close that window, the program will close.
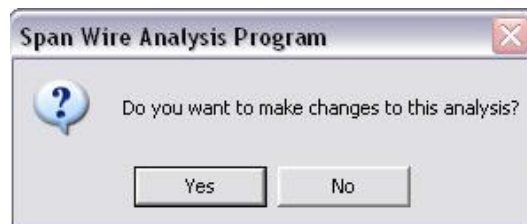
NOTE: If you have multiple signal assemblies in a project, you would select **New Intersection** from the "**File**" menu. A warning message will be displayed (Figure 11). The program will keep the existing Project Information, such as Name, PIN, Designer, etc. Remember to always **SAVE** your file. In this case, select "**No**", save your file and then proceed with a "**New Intersection**".
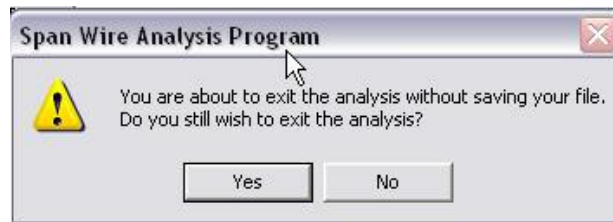
Figure 11

To save a file, select "**Save**" from the "**File**" drop down menu. The dialog box shown in Figure 12 will be displayed. In order to avoid replacing existing files every time you save a file, you will have the chance to rename the file. The file name will be displayed and highlighted. The files will be stored in this directory: *C:\DOTPrograms\SpanWire\data*
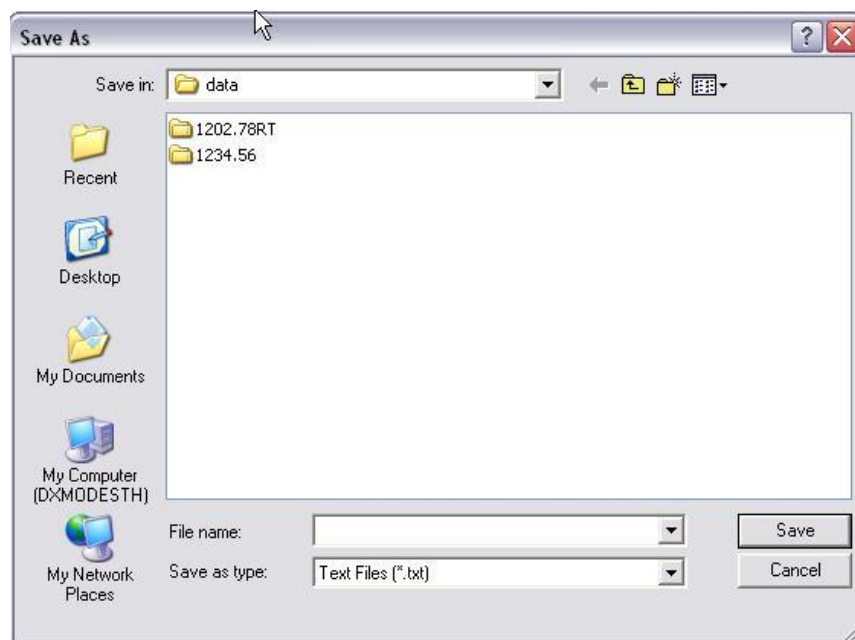
Figure 12

Saved files can be opened anytime for editing and/or analysis. The dialog box (Figure 13) looks very similar to the "save file" dialog box above. Select the file you want to open and click "**Open**". Now you are ready to make changes to the existing file. Remember to save your file after running the analysis.

Figure 13

APPENDIX A

SIGN AND SIGNAL SPECIFICATIONS   **(US Customary units)**

Dead Loads:

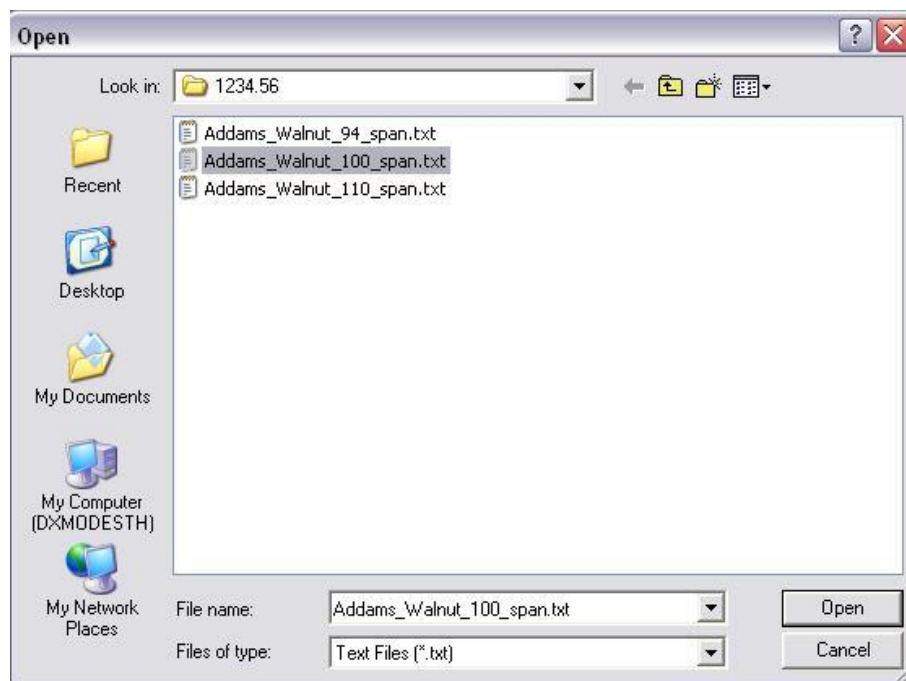| Description	Specification
12" Signal Section [a]	
- Aluminum (glass lens)	11.0 lbs [1]
- Aluminum (LED lens)	11.0 lbs [1]
- Polycarbonate (glass lens)	8.0 lbs [1]
- Polycarbonate (LED lens)	8.0 lbs [1]
8" Signal Section [a]	
- Aluminum (glass lens)	7.0 lbs [1]
- Aluminum (LED lens)	7.0 lbs [1]
- Polycarbonate (glass lens)	6.0 lbs [1]
- Polycarbonate (LED lens)	6.0 lbs [1]
Backplates:	
- Polycarbonate (12-12-12 configuration)	3.3 lbs [2]
- Polycarbonate (12-12-12-12 configuration)	4.2 lbs [2]
- Polycarbonate (8-8-8 configuration)	2.4 lbs [2]
- Polycarbonate (12-8-8 configuration)	3.2 lbs [2]
- Polycarbonate (12-8-8-8 configuration)	4.0 lbs [2]
Signal hanger [b]	
- 1-way hanger (vertical array)	9.5 lbs [3]
- 1-way hanger (doghouse array)	22.5 lbs
- 2-way hanger	20 lbs [3]
- 3-way hanger	25 lbs [3]
- 4-way hanger	30 lbs [3]
Disconnect Hanger (see M680-3)	10.5 lbs
Span wire cable [c]	
- 7/16"	1.0 lbs/ft
Sign hanger [d]	
- One-way (single panel)	Conduit length x 2.4 lb/ft + 7.2 lbs [1]
- Two-way (perpendicular)	" + 11.5 lbs [1]
- Two-way (back to back)	" + 9.5 lbs [1]
- Box kite (Type B)	" + 17.5 lbs [3]
Signs [e]	2.0 lbs/sf
LED Signs	9.0 lbs/sf

APPENDIX A (continued)

Ice Loads:

Description	Spec.
- Cable	0.6 lb/lf
- Signal Head (calculated for 4 sides)	3.0 lbs/sf
- Signs (one side only)	3.0 lbs/sf

Minimum Projected Areas:

Description	Spec.	
Signal section [f]		
- 8" (for wind load calc.)	0.68 sf	
- 8" (for ice load calc.)	0.68 sf	
- 12" (for wind load calc.)	1.24 sf	
- 12" (for ice load calc.)	1.00 sf	
Backplates (Net area):	**(5" border)**	**(8" border)**
- (12-12-12)	5.66 sf	9.08 sf
- (12-12-12-12)	7.00 sf	11.0 sf
- (8-8-8)	3.45 sf	6.22 sf
- (12-8-8)	4.94 sf	8.03 sf
- (12-8-8-8)	5.90 sf	9.42 sf
- (12-12-12-12-12)	8.99 sf	13.93 sf
Cable:		
- 7/16"	0.04 sf/ft	

Wind Load:

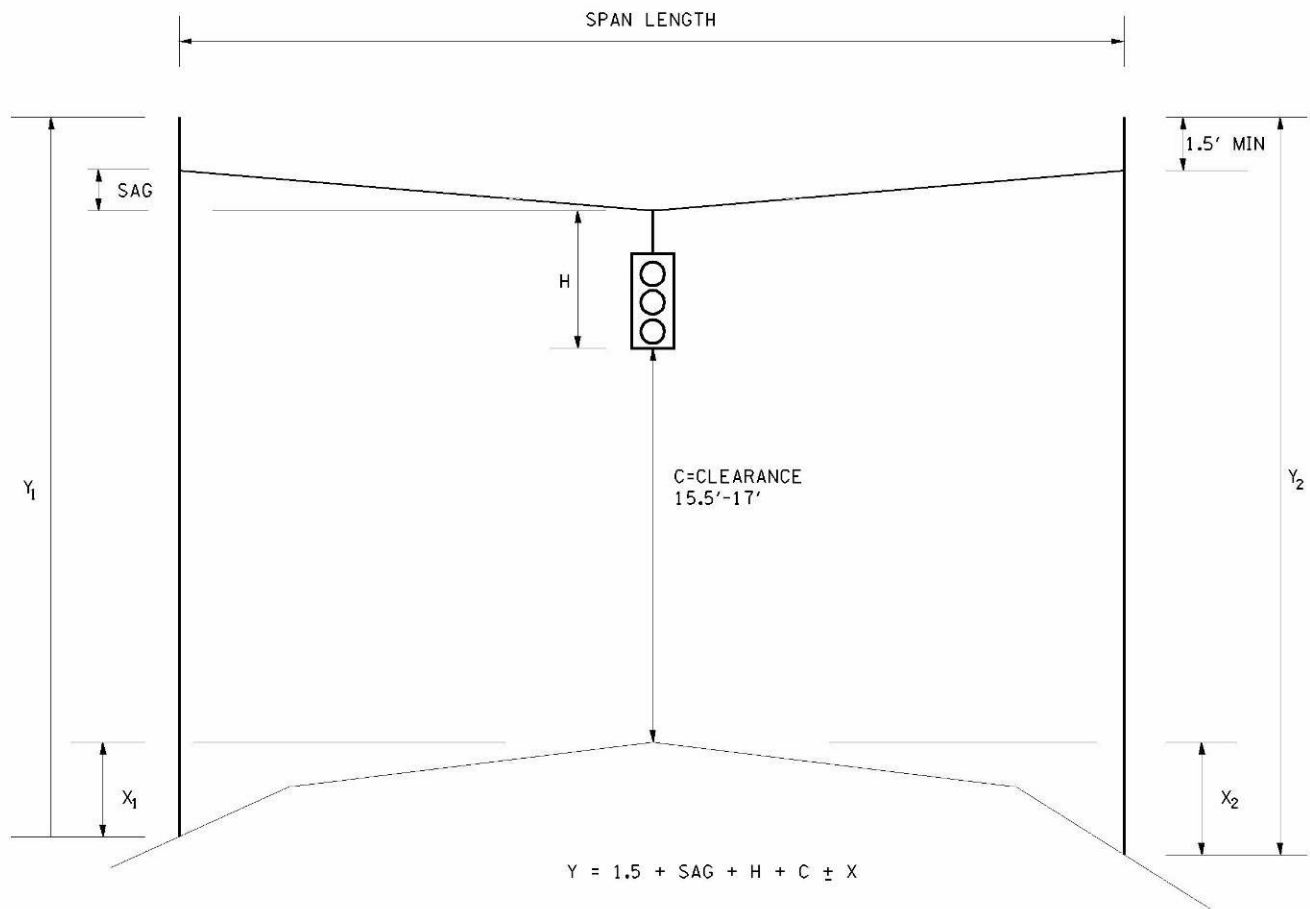| Description	Spec.
- Zone A (see standard spec 724-03)	70 mph, 25 lbs/sf
- Zone B (see standard spec 724-03)	80 mph, 33 lbs/sf
- Height Coefficient (C_h)	1.00
- Shape Coefficient (C_d)	1.20

[a] Includes housing, door, lens (Glass Lens, Bulb & Reflector or LED assembly) & visor

[b] Includes all assembly parts in standard sheet M680-3 (2 lb span wire clamp also included)

[c] Includes weight of signal control cable (span wire = 0.43 lbs/ft)

[d] Includes 2 lb span wire clamp

[e] Galvanized steel signs = 2.2 psf, Aluminum signs = 1.8 psf (use average of 2.0 psf)

[f] Dimensions obtained from Peek Traffic (Tallahassee, FL)

[1] NYS DOT Traffic Engineering & Highway Safety Division lab & signal shop (Region 1)

[2] Fortran Traffic Systems Limited (Ontario, Canada)

[3] Eagle Signal Corporation & the Crouse Hinds Corporation (taken from NYS DOT Traffic Signal Pole Design Program V. 1.5 - Specs table)

APPENDIX B

PIN: _____
PROJECT NAME: _____
SIGNAL NUMBER: _____

SPAN LENGTH

1.5' MIN

SAG

H

Y_1

C=CLEARANCE
15.5'–17'

Y_2

X_1

X_2

$$Y = 1.5 + SAG + H + C \pm X$$

+ 1.5	MINIMUM TOP DISTANCE AS PER STD. SHEET 680-14		+ 1.5
+	SAG = 5% OF SPAN (0.05 X SPAN LENGTH)		+
+	(H) HEAD & HANGER (4.6' FOR 12" LENSES & 3.6' FOR 8" LENSES) (H)		+
+	(C) CLEARANCE AT LOWEST HEAD (C)		+
$\pm$	(X_1) DIFFERENCE IN ELEVATION (X_2)		$\pm$
=	(Y_1) CALCULATED POLE LENGTH (Y_2)		=

APPENDIX C

SPAN WIRE ANALYSIS
SAMPLE DIAGRAM

PIN: _____

PROJECT NAME: _____

COUNTY: _____

SIGNAL NUMBER: _____

INTERSECTION NAME: _____

SPAN LENGTH

DIST #1   DIST #2   DIST #3   DIST #4**

DISTANCE BETWEEN POINT LOADS

POLE #1 HEIGHT

POLE #2 HEIGHT

PT. LOAD
#1

PT. LOAD
#2

PT. LOAD
#3

SIGNAL

SIGN

SIGNAL

__ # WAYS
__ # SECTIONS *

__ AREA

__ # WAYS
__ # SECTIONS *

__ TOTAL NUMBER OF SIGNALS (PT. LOADS)

__ TOTAL NUMBER OF SIGNS (PT. LOADS)

* TOTAL NUMBER OF LENS SECTIONS PER POINT LOAD
** REMAINING DISTANCE IS CALCULATED BY THE PROGRAM

LEFT
POLE
(POLE #1)

RIGHT
POLE
(POLE #2)